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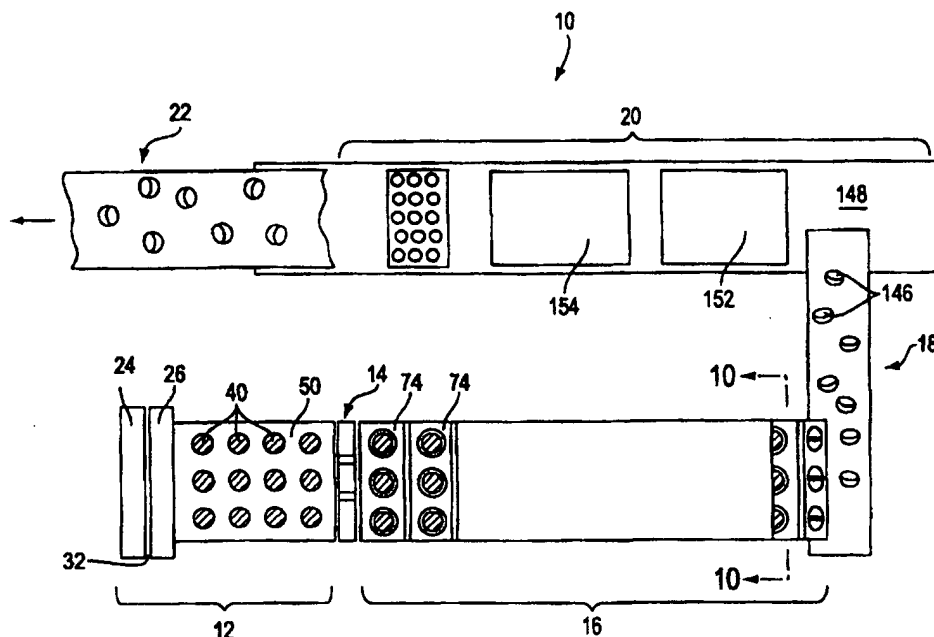
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(54) PROCEDE ET APPAREIL DE PRODUCTION DE PRODUITS  
ALIMENTAIRES DU TYPE GRIGNOTAGE EN FORME DE  
COUPELLE

(54) METHOD AND APPARATUS FOR MAKING BOWL-SHAPED  
SNACK FOOD PRODUCTS



(57) A method and apparatus for making bowl-shaped snack food products, e.g. tortilla chips. The method features placing chip preforms in open bowl-shaped cavities and partially frying the chip preforms by filling them with hot oil from above. Additionally, the preforms are partially fried from below by immersing the lower portions of the preforms in a vat of hot oil and transporting them through the hot oil. After cooking the preforms to a desired moisture content, at which point the preforms retain their bowl shapes outside of or independent of the mold cavities, the preforms are removed from the mold cavities and subsequently cooked to completion in a secondary frying operation. The invention also features an apparatus to carry out the method.

METHOD AND APPARATUS FOR MAKING BOWL-SHAPED  
SNACK FOOD PRODUCTS

BACKGROUND OF THE INVENTION

1. Technical Field

5           The invention relates generally to a method and apparatus for food production and, more specifically, to a method and apparatus for making fried, bowl- or other scoop-shaped snack food chips.

2. Description of the Background Art

10           In general, there are a number of food products which are shaped to help the product satisfy a particular function. For example, taco shells often are made by frying corn dough in a folded-over configuration to provide a U-shaped "trough" which is filled with the taco  
15 ingredients. With respect to snack food products, consumers often prefer a bowl- or scoop-shaped chip (corn chip, tortilla chip, potato chip, etc.) when eating chips

with dip (salsa, bean dip, cheese dip, etc.) because the bowl- or scoop-shaped configuration gives the chip strength -- thereby preventing breakage of the chip while scooping dip -- and allows the consumer to scoop up a  
5 larger, more satisfying portion of dip.

In the past, the methods and apparatus used to make such shaped products have been somewhat complex. In particular, they have tended to use closed molds in which the product is fixedly held while being cooked. Such  
10 configurations, although successful in the sense that they perform the desired function, are difficult to manufacture and prone to breakdown. Accordingly, there has been a need for a method and apparatus to make shaped fried food products (bowl-shaped snack food chips in particular) that  
15 is less complex and easier to operate than has been the case in the past.

#### SUMMARY OF THE INVENTION

The method and apparatus according to the invention satisfy this need. In particular, the invention features  
20 frying bowl- or scoop-shaped chip preforms by placing the preforms in bowl-shaped mold cavities to give the preforms a bowl shape, and filling the bowls of the preforms with hot oil to cook the chip preforms "from the inside."  
Preferably, the preforms are only partially cooked while  
25 in the mold cavities, i.e., to a moisture content at which

they are able to retain their bowl shape independent of the cavities. At that point, the preforms are removed from the cavities and cooked until completion in a second cooking step.

5           Thus, in a first aspect, the invention features a method of making a bowl-shaped snack food product. The method includes placing chip preforms made from uncooked dough in upwardly concave bowl-shaped mold cavities such that the chip preforms are formed into a bowl shape. The bowl-shaped preforms are then at least partially filled  
10           with oil that is hot enough to fry the dough such that the preforms are partially cooked by means of the hot oil. The partially cooked preforms are then removed from the mold cavities and cooked to completion in a second cooking  
15           step.

          In preferred embodiments, the preforms are fried in the first cooking step only until they are able to retain their bowl shape when removed from the mold cavities, i.e., when they have reached a predetermined moisture  
20           content. Furthermore, lower portions of the chip preforms may be disposed in hot oil so that the preforms are cooked "from the outside" of the bowl. This may be accomplished by having the mold cavities perforated and dipping the bottom portions of the mold cavities in hot oil. The chip  
25           preforms may be removed from the mold cavities by

inverting the mold cavities, preferably while simultaneously pushing the preforms out of the cavities by means of ejector members which extend into the mold cavities.

5            Preferably, the preforms are cooked to completion in a second vat of hot oil. They may be removed from the vat of hot oil by a conveyer that extends out of the vat. Preferably, the preforms are given a desired open-end-down configuration by being dunked or  
10 submerged more deeply into the oil and then allowed to float back up to the surface of the oil, with hydrodynamic drag forces causing the bowl-shaped preforms to become inverted as they float up.

            In another aspect, the invention features a method of  
15 making a bowl-shaped snack food product, in which method chip preforms made of uncooked dough are disposed in upwardly concave, bowl-shaped mold cavities such that they are formed into a bowl shape, and the bowl-shaped preforms are not restrained within the cavities. The unrestrained  
20 preforms are then at least partially fried while in the mold cavities, e.g., by being filled with hot oil. Preferably, the preforms are simultaneously fried by having their lower portions partially emerged into a vat of hot oil.

In yet another aspect, the invention features a method of making a bowl-shaped snack food product, in which bowl-shaped chip preforms, which are able to retain their bowl shape independently of any forming means, are  
5 disposed in a vat of hot oil to fry the dough and fried until they are fully cooked.

In a still further aspect, the invention features a method of removing cooked food product pieces from a vat of a cooking medium, e.g. hot oil, with a desired  
10 orientation to facilitate draining of the pieces. The food product pieces are submerged more deeply in the cooking medium as they float downstream in the medium, and hydrodynamic drag forces cause the food product pieces to assume a desired orientation as they float up to the  
15 surface.

In another aspect, the invention features an apparatus for making bowl-shaped food product. The apparatus includes a housing and a plurality of mold bodies disposed within the housing. The mold bodies each  
20 have one or more upwardly opening bowl-shaped cavities into which chip preforms made from uncooked dough are placed to give the chip preforms a bowl shape. The apparatus includes a cooking medium distribution system, e.g. an array of nozzle pipes, located above the mold  
25 bodies to fill the bowl-shaped preforms with a first

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cooking medium, e.g. hot oil, thereby cooking the preforms from the insides thereof.

Preferably, the mold bodies are configured to move through the housing, e.g., by having several mold bodies  
5 linked together into an endless belt which is disposed within the housing. Preferably, the apparatus is configured such that lower portions of the mold cavities are immersed into a vat or pool of hot oil and the mold cavities have perforated walls which allow hot oil to flow  
10 up into the cavities from below, thereby cooking the chip preforms from below, i.e., from the outside of the bowls. Preferably, the apparatus is configured such that the preforms are filled with the cooking medium from above before the preforms are partially immersed into the medium  
15 below.

In preferred embodiments, the mold bodies are connected in an endless belt which is trained around one or more ejector wheels. The ejector wheels extend partially up into the cavities through slots in the  
20 bottoms of the cavities to help eject the partially cooked preforms from the cavities.

The apparatus may include a conveyor assembly which transports the preforms to the mold bodies, and an air cushion transfer chute which transfers the chip or  
25 preforms from conveyor assembly into the mold cavities.

The apparatus may further include a secondary cooking station where cooking of the chip preforms is completed, e.g., a vat for forming a pool or a bath of a second cooking medium such as hot oil. The chip preforms may be removed from the vat by means of a conveyor extending out of the vat, and preferably the vat has a chip orienting means that gives the chips a desired orientation before they are carried out of the hot oil, e.g., a reciprocating plunger which dunks the snack food product pieces and allows them to float back up to the surface with hydrodynamic forces (drag) causing the snack food product pieces to assume the desired orientation.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail in connection with the drawings, in which coiling

Fig. 1 is a schematic plan view of an apparatus for making bowl-shaped snack food products according to the invention;

Fig. 2 is a schematic perspective view showing the sheeting and die-cutting portion of the apparatus shown in Fig. 1;

Figs. 2A and 2B are a side elevation view and a flat pattern view, respectively, of the cutter roller shown in Fig. 2;



Fig. 3 is a schematic perspective view showing an air slide conveyor arrangement according to the invention;

Figs. 3A and 3B are a section view and a detailed view, respectively, of the air slide taken along the lines  
5 3A-3A and 3B-3B, respectively, in Fig. 3;

Figs 4A, 4B, and 4C are schematic side elevation, plan, and end views, respectively, of the partial fryer shown in Fig. 1;

Fig 5. is a schematic perspective view showing three  
10 mold plate links in a continuous belt of mold plates in which bowl-shaped snack food products are made according to the invention;

Fig. 6 is a schematic perspective view of a conformal oil pan used in the partial fryer shown in Fig. 1;

15 Fig. 7 is a schematic view showing hot oil filling and cooking bowl-shaped chip preforms with oil according to the invention;

Fig. 8 is a schematic detail view showing a baffle or flow diverter used to reduce the force of impact of the  
20 oil filling the bowl-shaped preforms in Fig. 7;

Fig. 9 is a schematic perspective view showing sprocket drive wheels and ejector wheels used in the partial fryer shown in Fig. 1;

Fig. 10 is a schematic section view, taken along the lines 10-10 in Fig. 1, showing the operation of the ejector wheels of Fig. 9;

Figs. 11A and 11B are a schematic side elevation view and a plan view, respectively, of the secondary fryer shown in Fig. 1.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A schematic plan view of a preferred embodiment of the invention is shown in Fig. 1. The apparatus 10 includes a sheeting and die-cutting portion 12; an air slide 14; a partial fryer 16; a transfer conveyor 18; a secondary fryer 20; and a final product take-away conveyor 22.

As shown in Fig. 2, the sheeting and die-cutting portion 12 includes at least one pair of sheeter rollers 24, 26 and a cutter roller 28, which is shown in greater detail in Figs. a, b, and 2C. Corn masa, which has been fed to a masa "hog" or hopper from a set of grinding stones along with a secondary stream of water to achieve a moisture content of approximately 49.5% and an average grain size of approximately 0.024 inch, is fed between the sheeter rollers 24, 26 as is known in the art. The sheeter rollers 24, 26, which rotate in the directions indicated by arrows 28, 30, are separated by a gap 32 on

the order of 0.032 inch to form a sheet of masa which preferably is on the order of 0.032 inch thick.

Preferably, the width of the gap 32 is adjustable. Cutter roller 28, which rotates in the direction shown by arrow 34, has upstanding, preferably circular die-cutting ridges 36, as shown in Figs. 2A and 2B (but not in Fig. 2). The cutter roller 28 is positioned such that the die-cutting ridges 36 contact the surface of sheeter roller 26. Thus, as the corn masa (or any other dough that might be used with the invention) is sheeted between the rollers 24, 26 and wraps around the bottom portion of the roller 26, it is cut into circular dough preforms 40 (Fig. 1), much like cutting dough with a cookie cutter and as generally is known in the art.

As further shown in Fig. 2, the sheeting and die-cutting portion 12 includes a preform removal assembly 42 (not shown in Fig. 1). The preform removal assembly 42 consists of a support bar 44 or equivalent support member that is attached in front of sheeter roller 26, preferably to the frame (not shown) supporting the sheeter and die-cutter rollers. A set of wing knives 46 is secured to support bar 44, with one wing knife 46 for each "column" of chip preforms formed by the cutter roller 28. The wing knives 46 taper in width from the support bar 44 to their tips 48, which are disposed against the surface of the

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sheeter roller 26. As the sheeter roller 26 rotates with the corn masa sheet clinging to it, the wing knives 46 lift the circular chip preforms 40 from the surface of the sheeter roller 26, and the preforms drop onto conveyor belt 50. The masa "lace," i.e., the part of the masa sheet surrounding the chip preforms, rotates back around into the gap 32 and is mixed with additional masa being fed between the sheeter rollers.

Preferably, the cutter roller 28 is configured such that the chip preforms formed by the cutting ridges 36 are laterally evenly spaced, i.e., along the length of the sheeter rollers or, in other words, transverse to the direction of travel of the conveyor 50 as shown in Fig. 1. Furthermore, it is essential that the cutter roller 28 be configured such that the chip preforms in each of the columns be aligned in rows extending transversely across the conveyor 50, as shown in Fig. 1 as well.

The conveyor 50 transports the chip preforms 40 to the partial fryer 16. As described in greater detail below, the partial fryer 16 has a continuous belt of perforated mold plates having mold cavities formed therein, one of which mold plates is shown in Fig. 3. As further shown in Fig. 3, the air slide 14 is positioned at the downstream end of the conveyor 50 and is located just

above the mold plates, at the leftmost end of the partial fryer 16 as it is shown in Fig. 1.

As illustrated in Fig. 3A, the air slide 14 is formed from sheet metal which defines a plenum or chamber 56.

5 The plenum 56 is bounded by a back wall 58 and a perforated front or slide wall 60. The ends of the plenum 56 are bounded by end plates 62 (Fig. 3), and guide rails 64 are attached to the front of slide wall 60, e.g., by welding. The end plates 62 extend slightly above the  
10 slide wall 60 such that they, along with the guide rails 64, help guide the chip preforms into the mold cavities.

Air inlet pipes 66 and 68 extend into the plenum 56 through apertures in the respective end plates 62 and are secured therein, e.g., by welding. Pressurized air is  
15 pumped into the plenum 56 through the air inlet pipes and, as shown in Fig. 3A, flows out of the plenum 56 through perforations 70 in the front or slide wall 60. This creates a slight cushion of air above the surface of the air slide 14 which helps the chip preforms 40 slide  
20 smoothly and cleanly into the mold cavities, much like an "air hockey" disk sliding over an "air hockey" table.

As shown in Fig. 3B, the perforations 70 are drilled, e.g., by laser, so that they have a generally inverted teardrop profile. This helps direct the air flowing out  
25 of the plenum downward along the surface of the front or

slide wall 60, as opposed to straight through or perpendicular to the wall. This feature is important (as, in general, is the air cushion provided by the air slide) in order to ensure that the chip preforms 40 slide smoothly into their respective mold cavities. This prevents them from blowing upward off of or dragging along the air slide 14, either of which could cause the preforms to get folded over in the mold cavities, thereby leading to deformed, wasted product.

10           The centerpiece of the apparatus according to the invention is the partial fryer 16, which is shown in detail in Figs. 4A, 4B, and 4C. As noted above, the partial fryer 16 includes a continuous belt of perforated mold plates with mold cavities formed therein, as shown in greater detail in Fig. 5. The "links" of the continuous belt 72 are each composed of a perforated mold plate 74. The mold plates 74 are formed, e.g., from aluminum stock on the order of one sixteenth inch thick and have a multitude of perforations 76 extending through the stock.

15           Each of the mold plates 74 has a number of mold cavities 78, e.g. 3, formed as circular depressions in the plate.

Each mold plate 74 is attached to (e.g. by screws or rivets not shown) and supported by a pair of support members 80. A pair of pins or axles (not visible in Fig. 5) extends laterally from each support member 80. A

20           

25

spacer plate 82 fits over the two pins or axles and against each of the support members 80. Link members 84 are then fitted over the adjacent pins or axles of adjacent support members so as to "straddle" two adjacent support members and link them together. Roller bearing spacers 86 are then placed over the pins or axles, followed by link members 88 which, like link members 84, fit over adjacent pins or axles extending from adjacent support members to straddle, and thereby link, adjacent support members. Finally, retainer links 90 are fit over the ends of each pair of pins or axles and are secured thereto, e.g., by flattening the ends 92 of the pins or axles. In this manner, the continuous chain or belt of mold plates is assembled, with each link of the chain constituting a mold plate with mold cavities 78.

As shown in Figs. 4A and 4C, the belt 72 is trained around and driven by sprocket drive wheels 96, 98 at either end of the partial fryer 16 (Fig. 4A) and travels through a frying chamber 100 extending through the middle of and substantially along the length of partial fryer 16 (Fig. 4C). The pins or axles extending from the support members 80 should be spaced relative to each other such that the roller bearing spacers 86 are all evenly spaced, as illustrated in Fig. 4A, and the roller bearing spacers 86 should have a large enough diameter such that

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they support the belt 72 on upper and lower guide rails 102 and 104 which extend along the walls of the frying chamber 100.

In addition to the belt 72 of mold plates, another  
5 primary component of the partial fryer 16 is an oil  
distribution manifold system 110. The oil distribution  
manifold system includes a central distribution conduit  
112 with oil nozzle pipes 114 branching off of and  
extending down from the central distribution conduit 112.  
10 The oil nozzle pipes are arranged in an array over the  
belt 72, with the same number of "columns" of pipes in the  
array as there are mold cavities 78 in each plate 72.

The partial fryer 16 also includes heaters (not  
shown) which heat frying oil to the desired temperature,  
15 and requisite plumbing, e.g., pump system 116 and conduit  
118 leading from the pump 116 to the central oil  
distribution conduit 112. Thus, hot oil is circulated  
through the partial fryer by being pumped through conduit  
118 into central distribution conduit 112, and then  
20 flowing freely through and out of the oil nozzle pipes 114  
as the belt 72 travels under the outlets from the pipes.  
The hot oil is collected by oil return pan 120 and  
returned to the pump system 116 by appropriate drain means  
(not shown).



As explained in greater detail below, the chip preforms are carried through the partial fryer 16 in the mold cavities 78 and are partially fried by hot oil showering down on them from the oil nozzle pipes 114.

5 Additionally, the chip preforms preferably are cooked from below by being carried through a bath of hot oil, which is able to flow up and around the preforms in the bowl-shaped mold cavities 78 through the apertures 76 in the mold plates and through release slots 122 in the bottoms of the

10 mold cavities 78 (Fig. 4), the primary purpose of which will be described below. The bath of hot oil is formed by controlling the flow rate of oil through the system such that oil pools below the preforms contained within the open mold cavities. To reduce the volume of oil that must

15 be pooled, it is preferable to use a conformal oil pan 124 positioned below the upper flight of the belt 72. See Figs. 4C, 6, and 7. Advantageously, a minimum amount of oil remains inside the fryer, thereby maximizing "oil turnover" and helping to prevent oil degradation. Oil

20 spilling over the edges or ends of the conformal oil pan 124 is caught by the collector pan 120 and recirculated through the system.

Thus, it will be understood that the chip preforms are transferred from the conveyor 50 into the open mold

25 cavities 78 by sliding down along the air slide 14 into

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the mold cavities, as shown in Figs. 1 and 3, and then they are partially cooked in the partial fryer 16 as they are transported under a cascade of hot oil which fills the chip preforms from above to cook the bowl-shaped preforms from the inside. Additionally, the chip preforms are lowered into a pool of hot oil so that hot oil flows up and around the preforms from below to cook the bowl-shaped preforms from the outside. This approach to cooking the chip preforms -- cooking them with oil both inside the bowl and outside the bowl -- is preferred so as to avoid differential cooking, i.e., cooking from one side only, which can cause the final bowl-shaped chips to crack.

Preferably, the partial fryer 16 is constructed with the downstream end of the conformal pan 124 at a lower elevation than the upstream end. Additionally, the flow rate of oil preferably is controlled so that the pool of hot oil does not extend as far to the left (Fig. 4A) as the array of oil nozzle pipes 114 does. As a result, the bowl-shaped chip preforms begin to be filled with oil from above before they are partially immersed in the pool of hot oil below. This prevents the preforms from being floated up in the mold cavities by the oil bath below, which would ruin their bowl shape.

As shown in Fig. 8, it is preferable to attach a small baffle or flow diverter 130, e.g. a small vane, to

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the end of the oil nozzle pipes 114 (at least in the upstream-most row of oil nozzle pipes) such that the baffle or flow diverter 130 deflects or breaks up the flow of oil streaming out of the pipes 114. This prevents the oil from striking the uncooked chip preforms so hard that it tears them, particularly on the edges of the release slots 122 at the bottom of the mold cavities and more particularly before the preforms are partially immersed in oil from below.

Furthermore, as shown in Fig. 7, it is preferable that only about the lower third of the chip preforms are immersed in the bath of hot oil. This is because the chip preforms receive sufficient oil from above (i.e., inside the bowl) to be fried sufficiently from the bowl side, and immersing the mold cavities more deeply into the oil tends to cause the preforms to float up and out of the mold cavities.

The chip preforms are only partially cooked in the partial fryer 16. In particular, they are cooked just until they are sufficiently rigid to retain their bowl shape independent of the mold cavities 78. Thus, in a preferred embodiment of the invention using corn masa with an uncooked moisture content of 49.5%, an oil temperature of 360° F, and an oil flow rate through the system of six to eight gallons per minute with the velocity kept as low

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as possible to prevent tearing the preforms, the chip preforms will be fried to the desired, partially cooked state within approximately ten to fifteen seconds residence time in the hot oil. It should be noted, e.g., in Fig. 4A, that hot oil cascades down from the oil nozzle pipes 114 into the bowl-shaped preforms along most of the length of the partial fryer 16. This keeps the preforms filled with hot oil as they travel through the fryer and oil boils away, thereby ensuring that the temperature of the oil inside the bowls is elevated.

The length of the partial fryer 16 or, more easily, the linear speed of the belt 72 can be adjusted to control the residence time of the chip preforms in the oil. The rotational speeds of the sheeter and cutter rollers and the linear speed of the conveyor belt 50 used to transport the chip preforms from the sheeting/die-cutting rollers to the air slide 14 and into the mold cavities are also adjusted as the speed of the belt 72 is adjusted such that all of the above-mentioned units are synchronized. This is so that the chip preforms are centered when they slide into the mold cavities.

Once the preforms are partially cooked to the desired state, e.g., to a moisture content on the order of 15% - 20%, they are "ramped up" out of the oil at the downstream end of the partial fryer 16 as the belt 72 rises along the

guide rail 102. As the mold plates 74 rotate around the sprocket drive wheels 98, the mold cavities are inverted and the partially cooked chip preforms are dumped out onto conveyor 18 (Fig. 1).

5           As shown in Fig. 9, the sprocket drive wheels 98 (shown schematically without teeth) are mounted on shaft 140 coaxially with a set (e.g. three, corresponding to the number of mold cavities 78 in each mold plate 74) of ejector disks 142. As shown in Fig. 10, the ejector disks  
10       142 extend slightly into the mold cavities 78 through release slots 122 and the bottoms of the cavities 78 as the mold plates 74 move into engagement with and rotate around the sprocket drive wheels 98. This helps dislodge any chips which may be stuck in the mold cavities.

15           As the mold cavities are inverted and the ejector disks extend through the release slots into the mold cavities, the partially fried chips 146 (Fig. 1) are dumped onto transfer conveyor 18. At this point in time, the chips 146 are sufficiently cooked to maintain their  
20       bowl shape outside of or independent of the mold cavities. The transfer conveyor 18 transports the partially cooked, bowl-shaped chips 146 to secondary fryer 20, where the partially fried chips are dropped into another fryer 148. Preferably, the transfer conveyor 18 is a wire mesh or  
25       chain link belt, which allows oil to drain from the chips.

As shown in Figs. 11A and 11B, the secondary fryer 20 comprises an elongated vat of hot oil 148. A pair of submergers 152, 154 are provided to submerge the chips and keep them submerged in the hot oil 148, as generally is known in the art. The submergers rotate in the direction indicated by arrows 156, 158, respectively, thereby moving the chips from right to left as shown in Figs. 11A and 11B. Other means (not shown) may also be provided to circulate the oil in that direction.

10 A chip orientation device 156 is located downstream of the submergers. The chip orientation device is provided to ensure that the chips are removed from the oil 148 by the take-away conveyer 22 bowl-side down. By having the chips so oriented, oil drains from the chips more thoroughly and does not settle or sit in the bowl of the chips, which can lead to over-cooking of the chips and/or to oil-soaked chips.

The chip orientation device 156 consists of a basket 160 that is made from wire mesh or perforated sheet metal. 20 The basket 160 is supported in the oil by plunger shaft 162 which, in turn, is supported by plunger driver 164. The plunger driver plunges the basket 160 up and down, into and out of the oil bath. As the basket 160 submerges, it pushes the bowl-shaped chips deeper into the 25 oil. Then, as the basket moves upward, the chips float up

toward the surface of the oil. As they do so, hydrodynamic forces on the chips automatically cause the chips to float up towards the surface with their bottoms up, i.e., with the open ends facing down. Preferably, the  
5 basket 160 is retracted upward faster than the chips float upward so that the chips are permitted to return toward the surface in an unhampered manner. Furthermore, the basket 160 preferably is oscillated up and down at a frequency on the order of two cycles per second, although  
10 the actual value will depend, for example, on the rate at which chips are moving through the system; chip volume; oil viscosity, velocity, and volume; fryer dimensions; etc.

As the chips float up toward the surface, they also  
15 continue to move downstream. They are then lifted out of the oil by the take-away conveyor 22, which carries the chips downstream for further processing, e.g. seasoning and packaging. Preferably, the final product take-away conveyor 22 is formed from wire mesh or metal links, and  
20 it may be formed from several stepped or staggered sections to facilitate draining of the oil from the chips as they tumble over the steps of the conveyor.

In general, the bath of oil 148 should be maintained at a temperature on the order of 360° F. The length of  
25 the secondary fryer 20 and/or the rate at which the chips

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move through the fryer is/are tailored such that for tortilla chips made from corn masa, the chips reside in the secondary fryer for approximately thirty-five to forty seconds. A final moisture content of the chips of 1.1% is most desirable, but a final moisture content of 0.6% to 2.4% is deemed to be acceptable. The oil residence time and oil temperatures in the partial fryer 16 and secondary fryer 20, as well as the intermediate and final product moisture content will, of course, vary somewhat depending on the particular type of snack food chips being manufactured.

With the above-described apparatus configuration and method, bowl-shaped snack food products, e.g. chips, can be made quickly, easily, and efficiently. Furthermore, by partially frying the chips in a partial fryer and then transferring the chips to a secondary fryer for completion of the cooking, the layout of the apparatus can be modified to take up relatively little floor space in the manufacturing facility. Additionally, the above-described configuration reduces the overall length of the processing line, which reduces the amount of oil being used. With less oil being used, it becomes easier to maintain the quality of the oil, which is recirculated through use, and hence the quality of the final product.



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Other embodiments and configurations are deemed to be within the scope of the following claims.

CLAIMS

1           1. A method of making a concave snack food product, said method comprising:  
2           disposing snack food product preforms made of uncooked dough in upwardly concave  
3           mold cavities, said snack food product preforms each thereby being formed into a concave  
4           shape having a cavity;  
5           at least partially filling the cavity of said snack food product preforms with oil that is  
6           at a temperature sufficient to fry the dough;  
7           partially cooking said snack food product preforms, by means of the oil inside the  
8           cavity of the preforms, in a first cooking step;  
9           removing said partially cooked snack food product preforms from said mold cavities;  
10          and  
11          completing cooking of said snack food product preforms in a second cooking step.

1           2. The method of claim 1, wherein said snack food product preforms are fried in said  
2           first cooking step only until said snack food product preforms are able to retain their concave  
3           shape when removed from said mold cavities.

1           3. The method of claim 1, wherein said snack food product preforms are fried in said  
2           first cooking step only until said snack food product preforms have a predetermined moisture  
3           content.

1           4. The method of claim 1, further comprising disposing lower portions of said snack  
2           food product preforms in oil that is at a temperature sufficient to fry the dough, during said  
3           first cooking step, so as to cook said snack food product preforms by means of oil exterior to  
4           the cavity of the preforms.

AMENDED SHEET

1           5. The method of claim 4, wherein said mold cavities have perforations which permit  
2 oil to flow therethrough, said method comprising transporting said mold cavities through a  
3 vat of oil with lower portions of said mold cavities and said lower portions of said snack food  
4 product preforms partially immersed in said vat of oil.

1           6. The method of claim 1, wherein said partially cooked snack food product preforms  
2 are removed from said mold cavities by inversion of said cavities.

1           7. The method of claim 1, wherein said partially cooked snack food product preforms  
2 are pushed out of said mold cavities by means of ejector members extending into said mold  
3 cavities.

1           8. The method of claim 1, further comprising frying said snack food product preforms  
2 in a vat of oil, at a temperature sufficient to fry the preforms, in said second cooking step and  
3 removing said snack food product preforms from said vat of oil when said snack food product  
4 preforms are fully cooked.

1           9. The method of claim 8, wherein said fully cooked snack food product preforms are  
2 removed from said vat of oil by means of a conveyor device partially submerged in and  
3 extending out of said vat of oil.

1           10. The method of claim 9, further comprising causing said snack food product  
2 preforms to be oriented in a desired orientation before said snack food product preforms are  
3 removed from said vat of oil.

1           11. The method of claim 10, wherein said snack food product preforms are caused to  
2 be oriented with the open portion of the concave shapes facing downward before said snack  
3 food product preforms are removed from the vat of oil.

1           12. The method of claim 11, wherein said snack food product preforms are caused to  
2 be oriented with the open portion of the concave shapes facing downward, before said snack  
3 food product preforms are removed from the vat of oil, by submerging said snack food  
4 product preforms more deeply in said vat of oil and allowing said snack food product  
5 preforms to float up toward the surface of the vat of oil, with hydrodynamic forces causing  
6 said snack food product preforms to assume said open-end-down orientation as they float up  
7 toward the surface of the vat of oil.

1           13. The method of claim 1, wherein said uncooked snack food product preforms are  
2 transported to said mold cavities on a conveyor and are slid along an air-cushioned transfer  
3 chute into said mold cavities.

1           14. A method of making a concave snack food product, said method comprising:  
2 disposing snack food product preforms made of uncooked dough in upwardly concave  
3 mold cavities, said snack food product preforms each thereby being formed into a concave  
4 shape with a cavity, said concave chip preforms being unrestrained within said mold cavities;  
5 and  
6 at least partially frying said snack food product preforms while in said mold cavities  
7 by filling the cavity of the preforms with oil that is at a temperature sufficient to fry the  
8 dough.

1           15. The method of claim 14, wherein said concave snack food product preforms are at  
2   least partially fried by being filled with hot oil.

1           16. The method of claim 14, wherein said mold cavities have perforations which  
2   permit oil to flow therethrough, said method further comprising transporting said mold  
3   cavities through a vat of oil at a temperature sufficient to fry the dough with lower portions of  
4   said mold cavities and lower portions of said snack food product preforms partially immersed  
5   in said vat of oil.

1           17. The method of claim 14, wherein said uncooked snack food product preforms are  
2   transported to said mold cavities on a conveyor and are slid along an air-cushioned transfer  
3   chute into said mold cavities.

1           18. A method of making concave snack food product, said method comprising:  
2       disposing partially cooked, concave snack food product preforms made of dough in a  
3   vat of oil that is at a temperature sufficient to fry the dough, said concave snack food product  
4   preforms being sufficiently pre-cooked to be able to retain their concave shape independently  
5   of any forming means;

6       frying said snack food product preforms while unrestrained in said vat of oil until the  
7   preforms are fully cooked; and

8       removing said fully cooked snack food product preforms from said vat of oil.

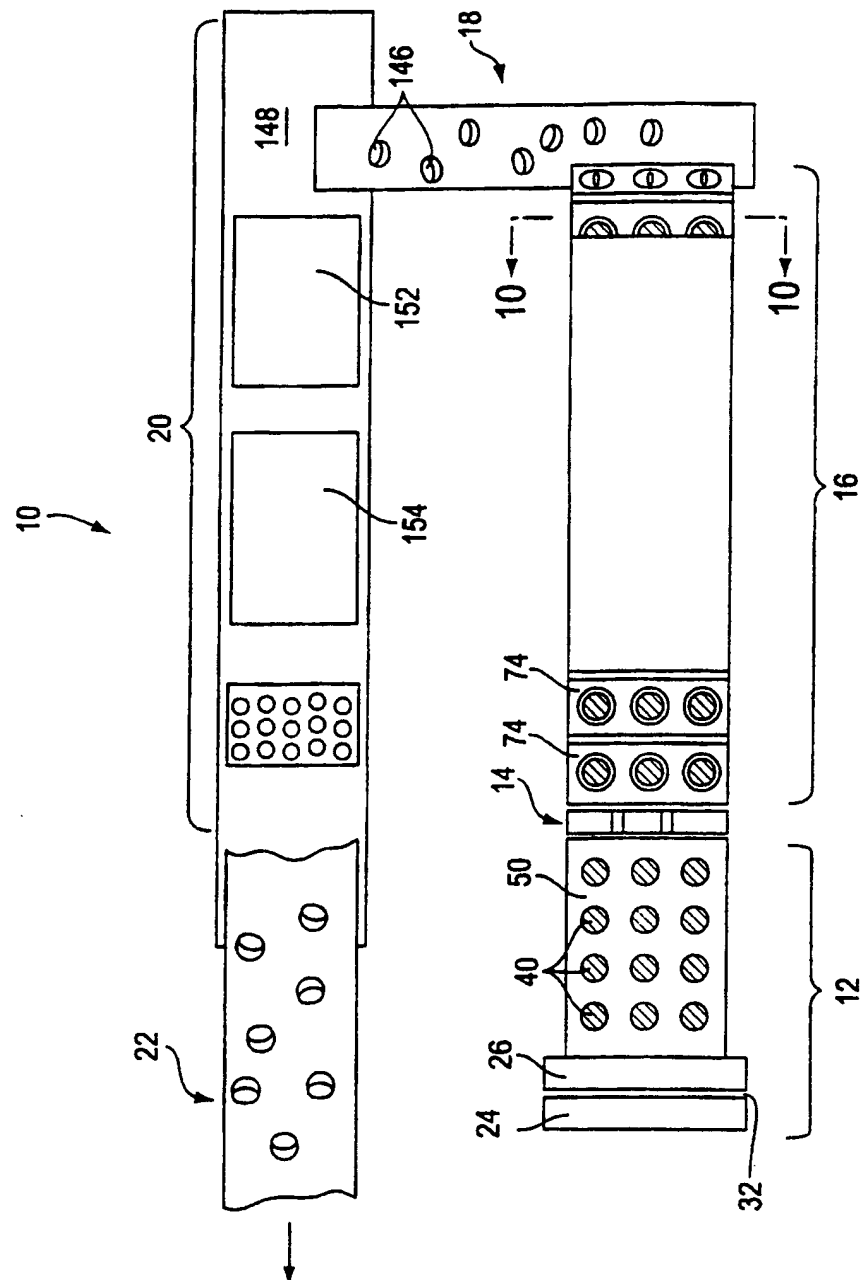
1           19. The method of claim 18, wherein said fully cooked snack food product preforms  
2   are removed from said vat of oil by means of a conveyor device partially submerged in and  
3   extending out of said vat of oil.

1           20. The method of claim 19, further comprising causing said snack food product  
2 preforms to be oriented in a desired orientation before said snack food product preforms are  
3 removed from said vat of oil.

1           21. The method of claim 20, wherein said snack food product preforms are caused to  
2 be oriented with the open portion of the concave shapes facing downward before said snack  
3 food product preforms are removed from the vat of oil.

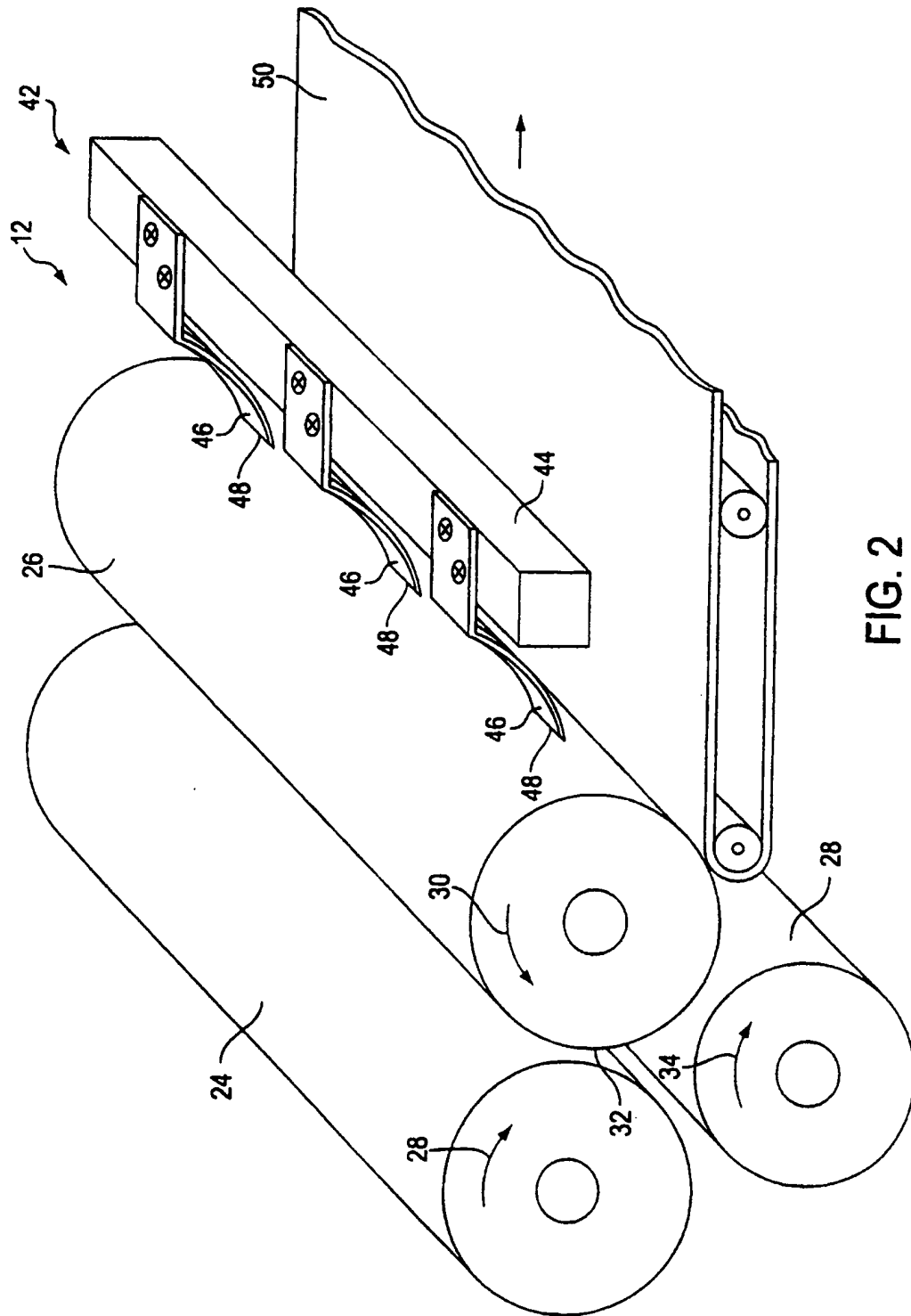
1           22. The method of claim 20, wherein said snack food product preforms are caused to  
2 be oriented with the open portion of the concave shapes facing downward, before said snack  
3 food product preforms are removed from the vat of oil, by submerging said snack food  
4 product preforms more deeply in said vat of oil and allowing said snack food product  
5 preforms to float up toward the surface of the vat of oil, with hydrodynamic forces causing  
6 said snack food product preforms to assume said open-end-down orientation as they float up  
7 toward the surface of the vat of oil.

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**FIG. 1**

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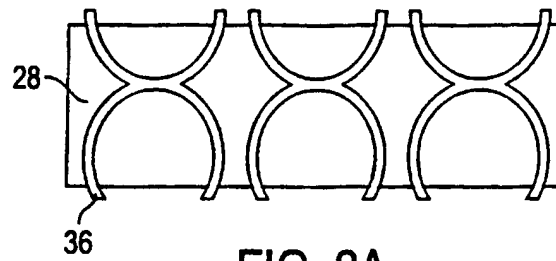


FIG. 2A

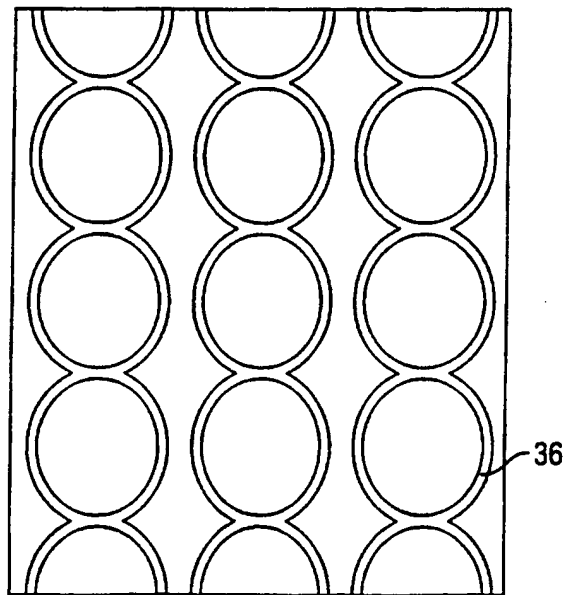
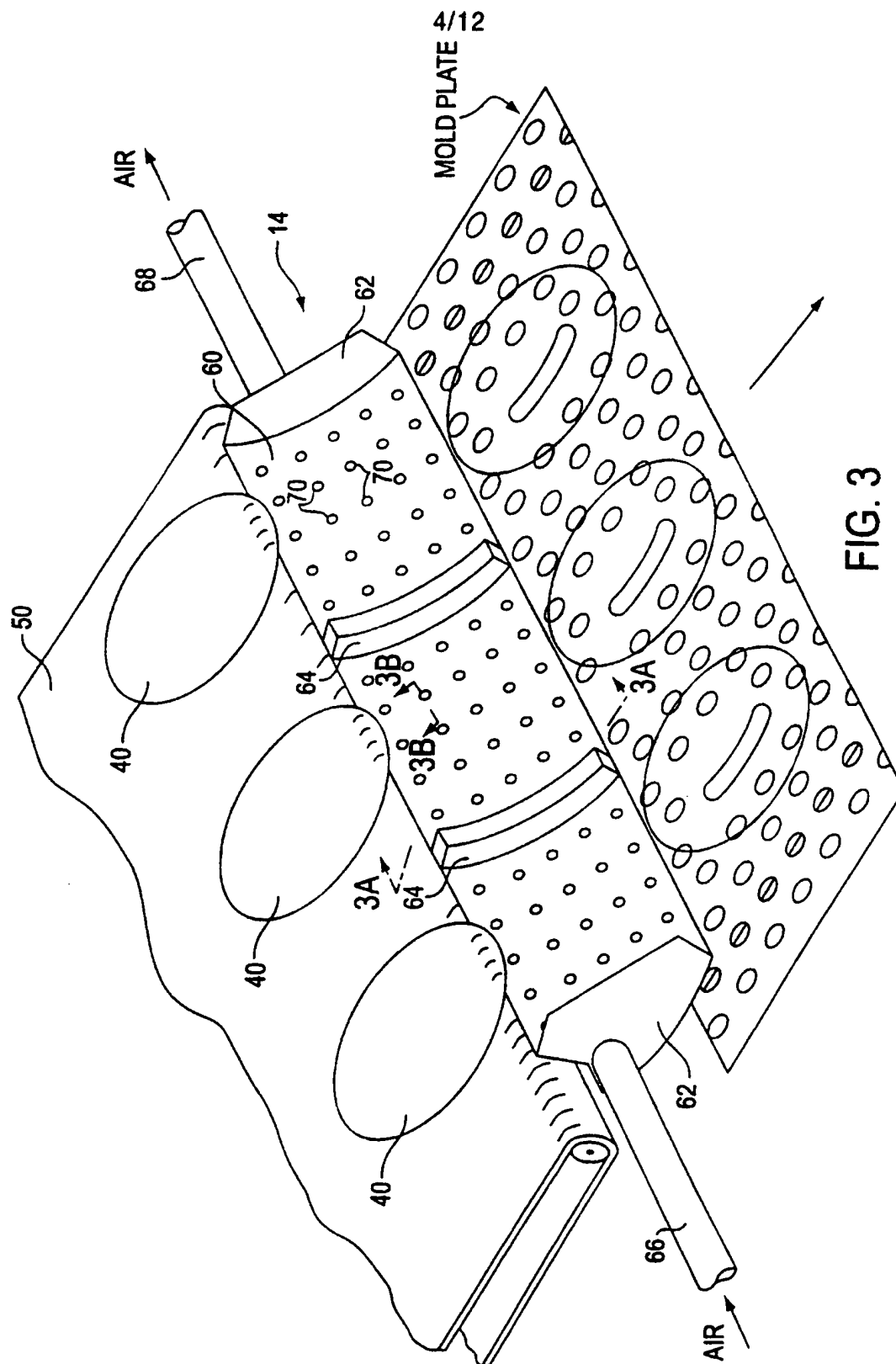


FIG. 2B



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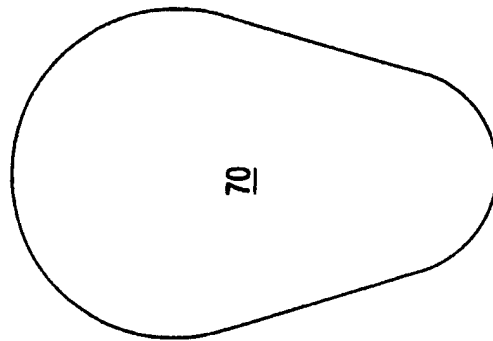


FIG. 3B

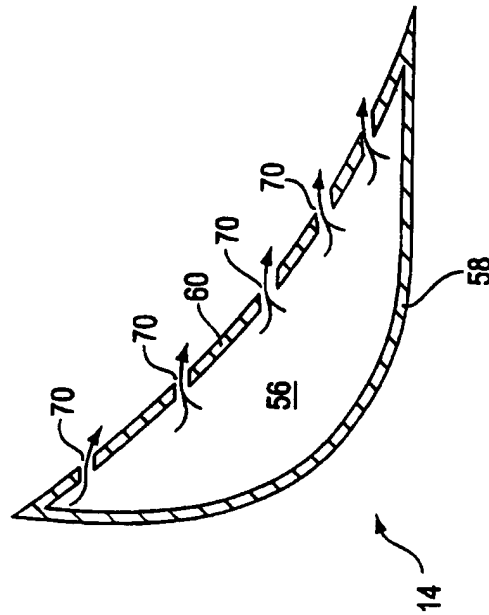
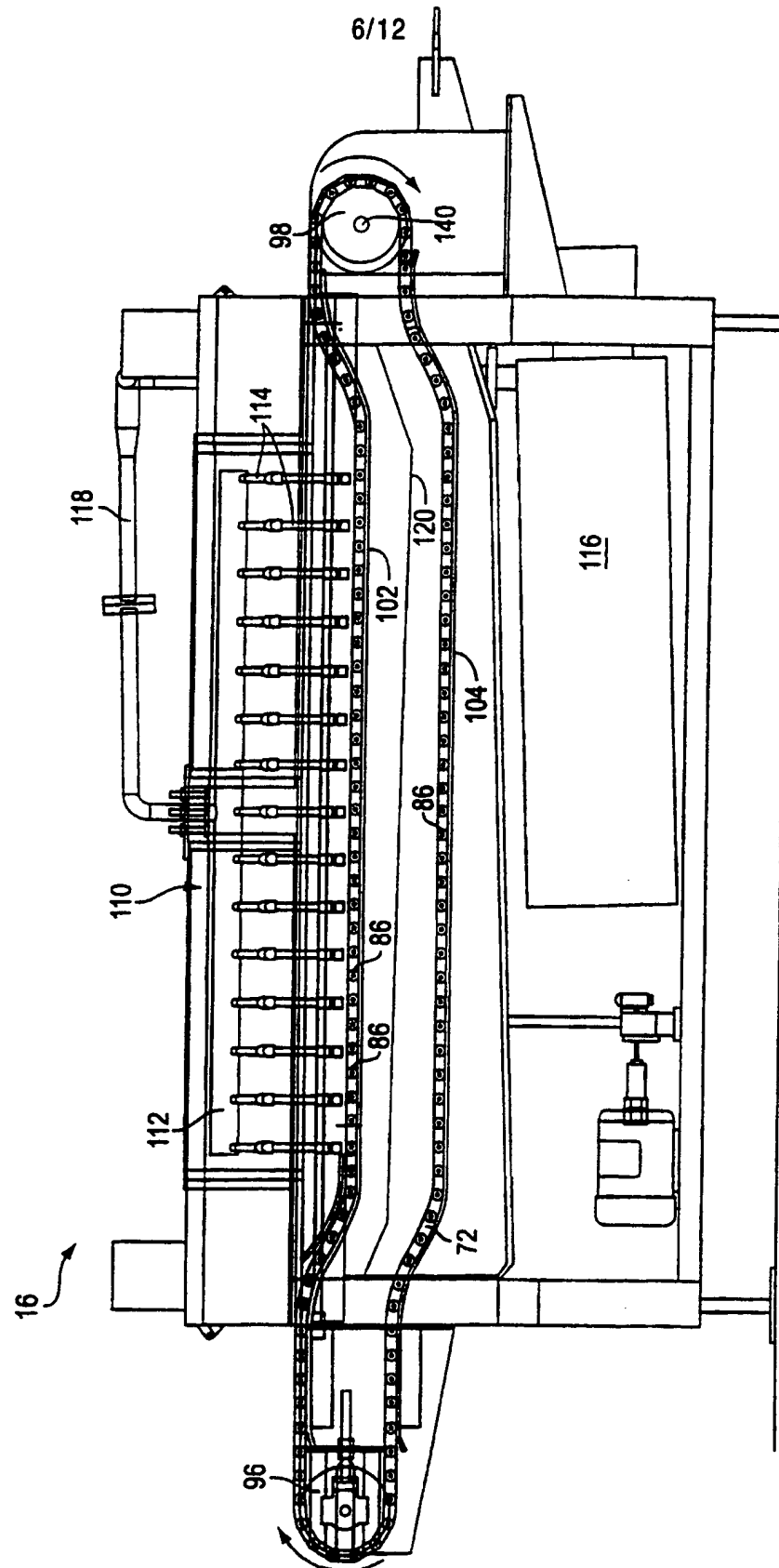


FIG. 3A



**FIG. 4A**

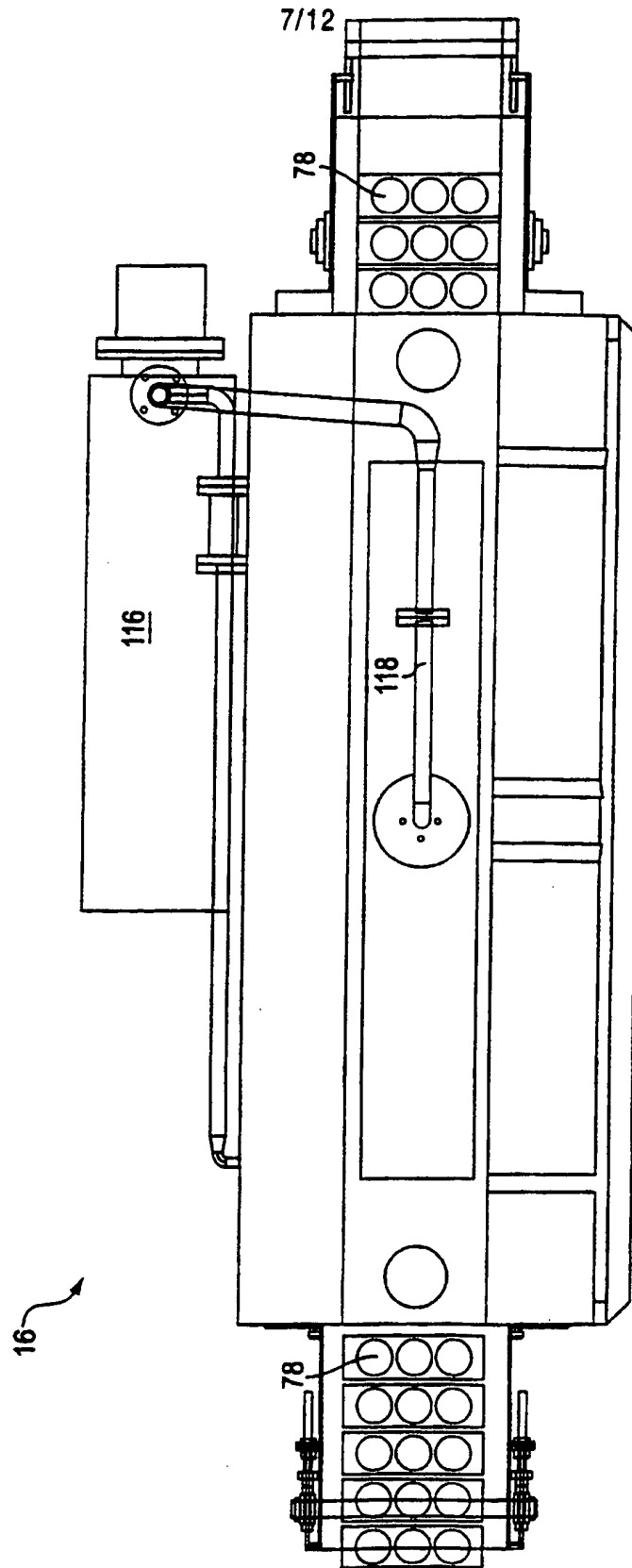


FIG. 4B

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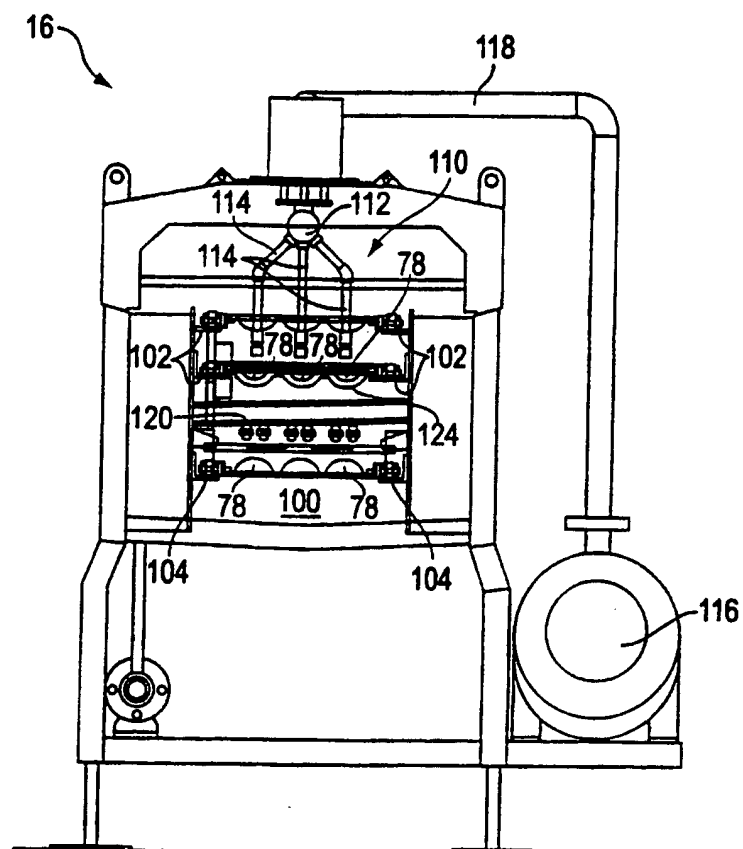


FIG. 4C

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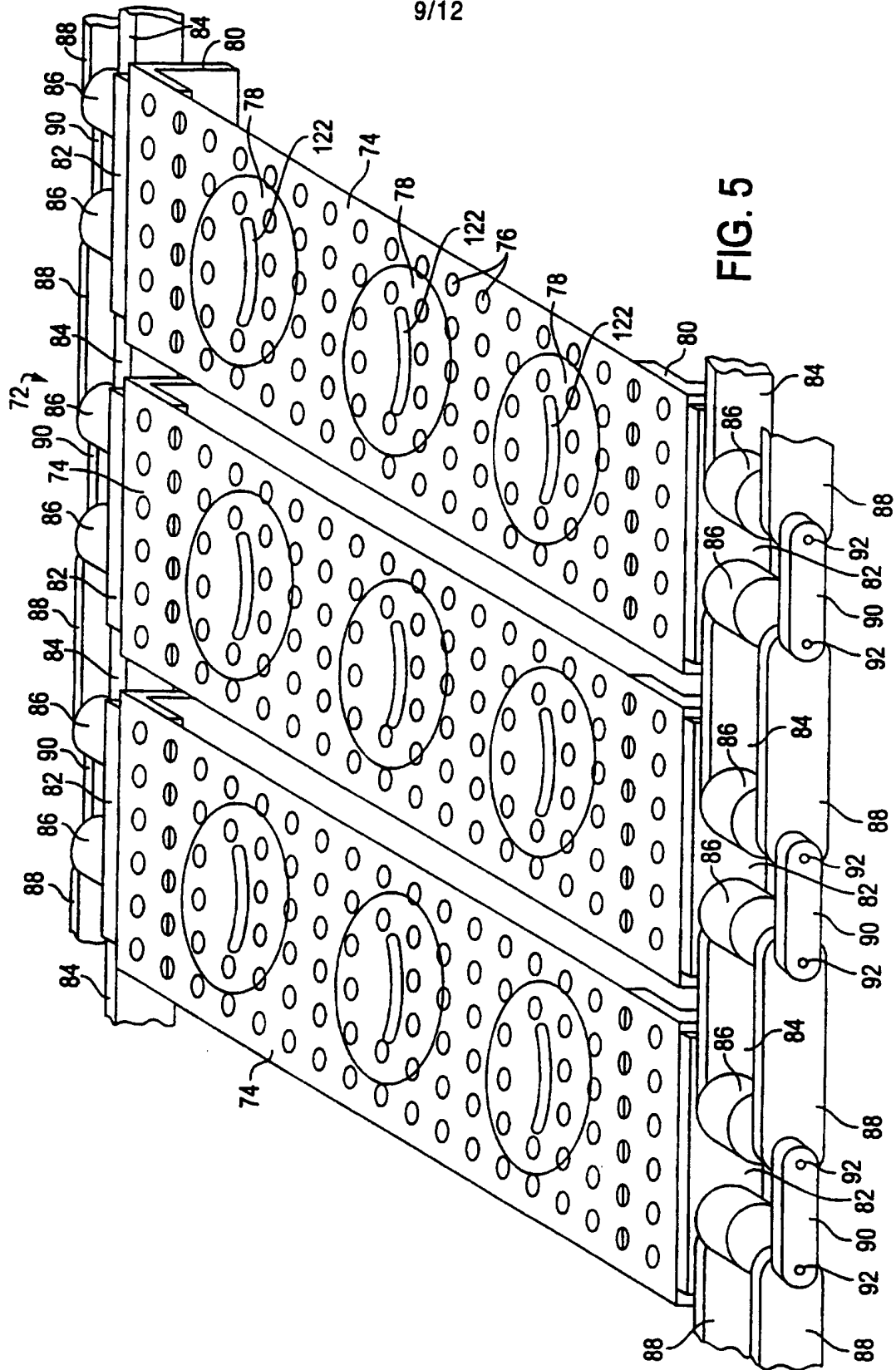


FIG. 5

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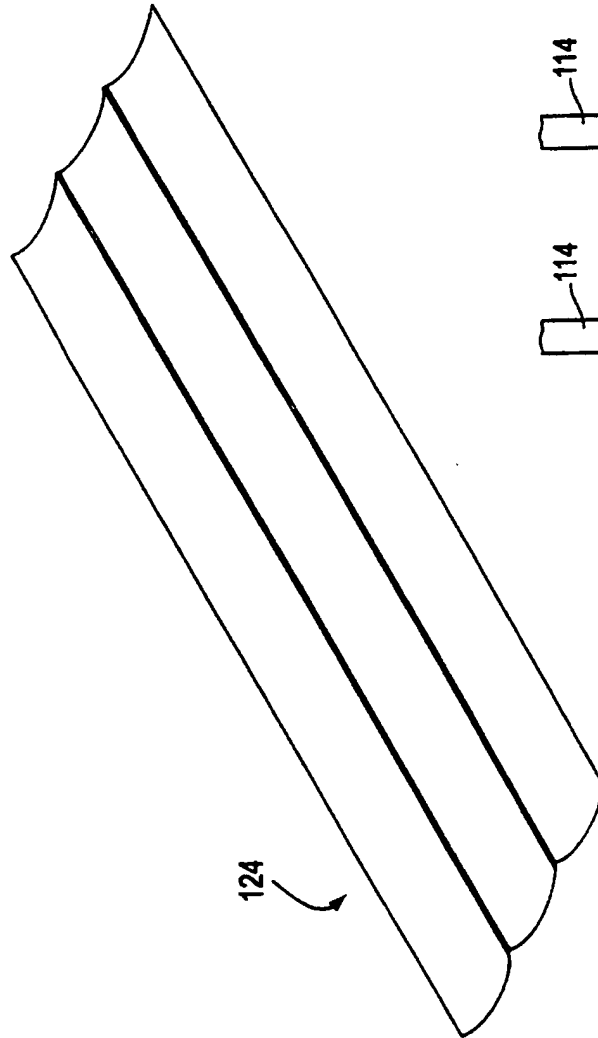


FIG. 6

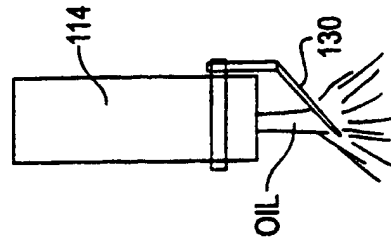


FIG. 8

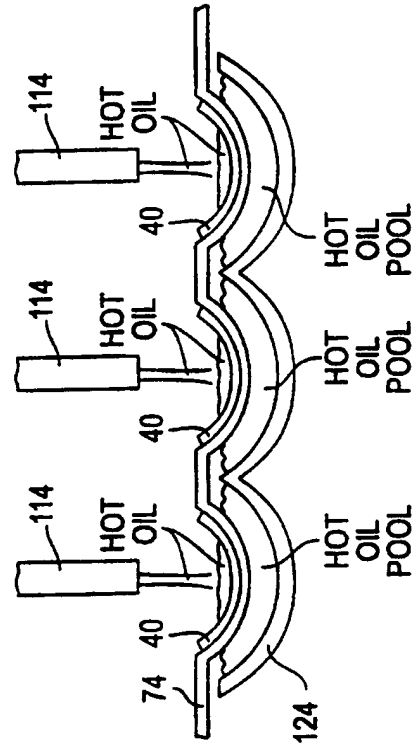


FIG. 7



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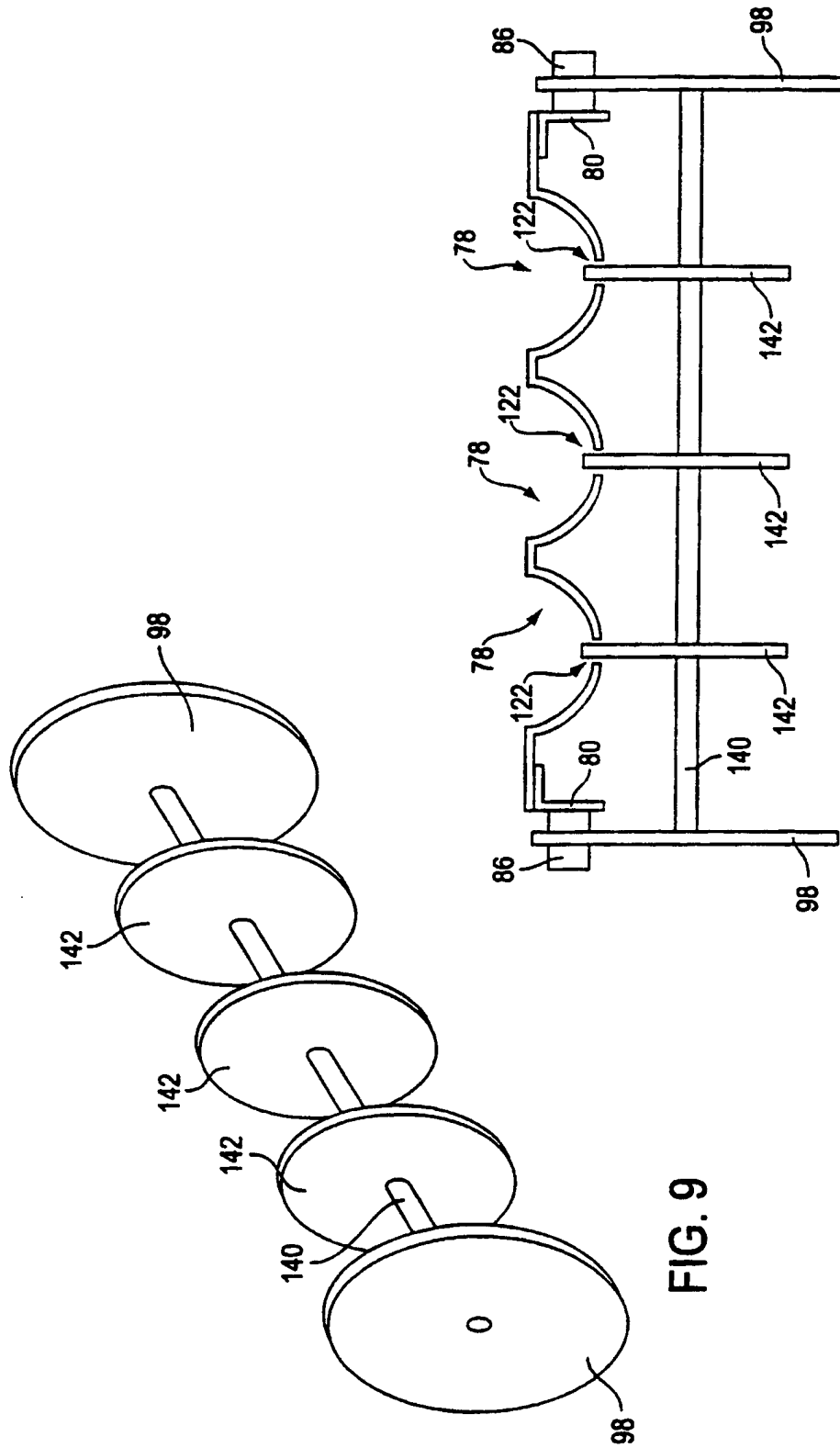
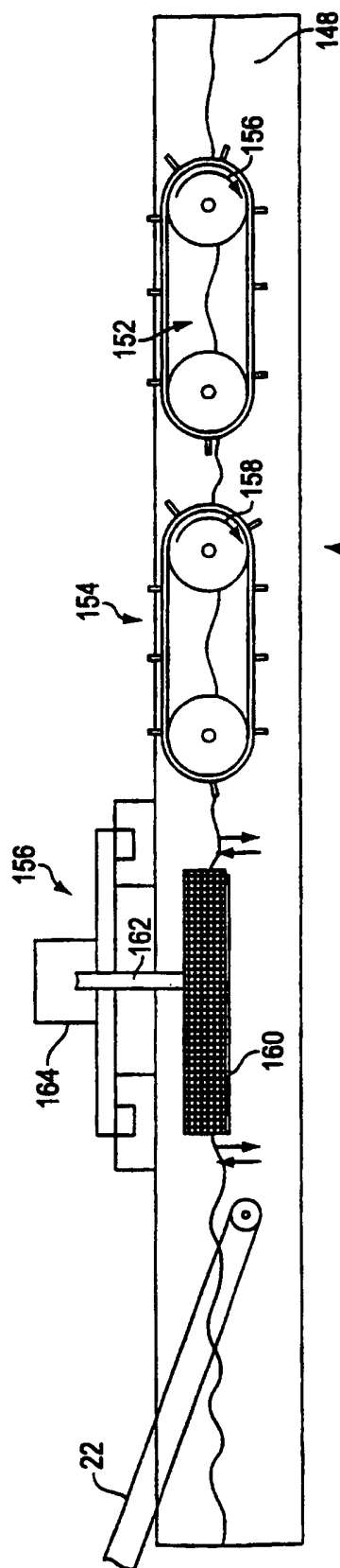


FIG. 10

FIG. 9



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FIG. 11A

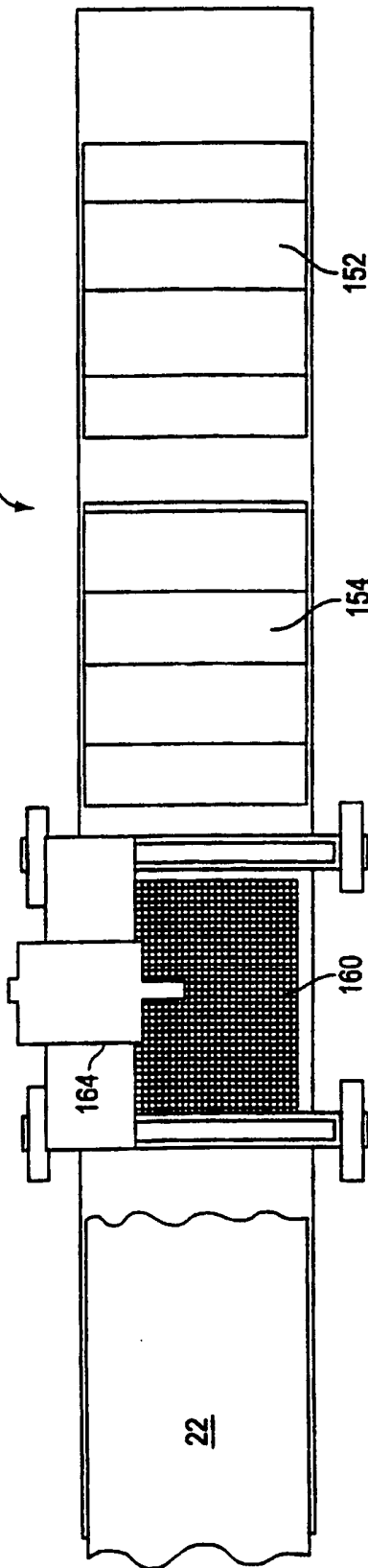


FIG. 11B